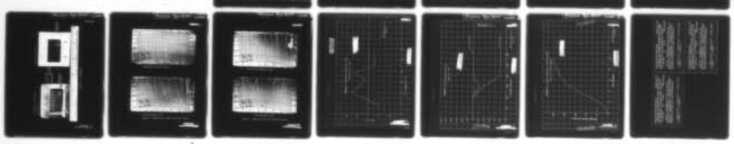
AD-A049 840 NAVY ELECTRONICS LAB SAN DIEGO CALIF F/G 8/10
EVALUATION OF PREPRODUCTION MODEL 3000-METER SURFACE-VESSEL BAT--ETC(U)
OCT 52 R A ROSS
UNCLASSIFIED NEL-345 NL

| OF |

AD
A049840



END
DATE
FILMED
3-78
DDC

#119

AD A049840

AD No.
DDC FILE COPY

MOST Project-2

UNCLASSIFIED

ST-12
REPORT 345
PROBLEM NEL 4G10
24 OCTOBER 1952

[redacted]

(12) 17p.

(14) NEL-345

(6)

Evaluation of Preproduction Model 3000-Meter Surface-Vessel Bathythermograph OC-6/S

(10) R. A. ROSS ENGINEERING DIVISION

DDC
RECEIVED
FEB 13 1978
A

345

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

DECLASSIFIED
DOD DIR 5200.9

U. S. NAVY ELECTRONICS LABORATORY, SAN DIEGO, CALIFORNIA

253 550

UNCLASSIFIED [redacted]

LB

~~This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law. Reproduction of this classified document in any form by other than naval activities is not authorized except by specific approval of the Secretary of the Navy.~~

UNCLASSIFIED [redacted]

ABSTRACT

Statement of problem: BuShips problem ST-12 (NEL 4G10): Conduct engineering tests and evaluation of 3000-Meter Bathythermograph OC-6/S, to determine acceptability for Naval use.

CONCLUSIONS

The bathythermograph as tested meets the specification with the following exceptions: the slide-retaining springs are too weak in both the grid holder and the pressure-bourdon slide carriage; the velocity grids are not marked for every 2 meters per second; and the temperature bourdon is not correctly temperature compensated.

RECOMMENDATIONS

1. Strengthen the spring which holds the slide in the pressure-bourdon slide carriage to prevent dislocation of slide.
2. Lengthen the pressure-bourdon pivot shaft to prevent dislocation of pressure bourdon.
3. Adjust the temperature-compensation section of the temperature bourdon.
4. Waive the specification requiring 2-meter markings of the isovelocity grids.

The laboratory evaluation was conducted by the author under the supervision of G. D. Shipway, and with the assistance of F. H. Skilton. Sea trials were made aboard the E. W. SCRIPPS, oceanographic vessel of the University of California, by B. Holtsmark and J. Roque.

Evaluation of this equipment was completed 18 September 1952.

ACCESSION for
NTIS White Section ☑
DDC Buff Section ☐
UNANNOUNCED ☐
JUSTIFICATION Letter on file
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. AVAIL. and/or SPECIAL
A

UNCLASSIFIED

CONTENTS

ILLUSTRATIONS

INTRODUCTION

This report covers testing of a 3000-meter preproduction model Surface-Vessel Bathythermograph, OC-6/S, manufactured by Engineering Laboratories, Inc., Garland, Texas, under Contract NObsr-52100. Operational performance, quality of construction, and ease of servicing in the field were evaluated for compliance with the specification.[1]

DESCRIPTION OF EQUIPMENT

The bathythermograph is cylindrical in shape. It is approximately 9 inches in diameter and 8 inches in over-all length (fig. 1). Its total weight is 60.5 pounds. The instrument consists of a sealed cylinder which contains the pressure and temperature bourdons (fig. 2) and a tail piece that is wrapped with the thermal-element tubing (fig. 1). External pressure is admitted to the pressure bourdon by means of a small screened inlet in the base of the pressure cylinder (fig. 3). The pressure bourdon (fig. 2) supports a smoked slide which is rotated about the bourdon axis as a function of the depth. The thermal bourdon (fig. 2) moves a stylus transversely across the smoked slide as a function of the temperature. The pressure bourdon pivot arm, the stylus lifter, and the slide-retaining spring are shown in figure 4.

Major accessories to the instrument include smoked slides, grid holders, and a viewer.

Function of the equipment is to obtain the relationship between temperature and depth to determine the velocity of sound in water at a salinity of 35.

TESTS

CALIBRATION

The accuracy of the manufacturer's temperature and depth calibration of the bathythermograph could not be tested because of damage sustained in shipment and during the tests. Upon arrival at this laboratory it was found that the counterbalance weight (fig. 2) on the temperature bourdon had become dislodged, evidently by shock and/or vibration sustained in transit. The counterbalance weight was resoldered by the manufacturer's representative. While the bathythermograph was being prepared for tests, it was accidentally dropped

[1] Military Specification No. MIL-B-15635 (Ships), Bathythermograph OC-6/S (3000-Meter Surface Vessel Use) (RESTRICTED), 15 August 1950.

six inches to the floor. This drop bent the pressure-bourdon pivot arm (fig. 4), which was straightened by the manufacturer's representative. During repairs the pressure and temperature calibration characteristics of the instrument were unavoidably changed. In order to bring the instrument as near as possible to correct calibration, the manufacturer's representative transferred the grid from the grid holder (having unadjustable pressure reference) supplied with the instrument to another grid holder which had an adjustable pressure reference (fig. 5).

Calibration of the bathythermograph was checked in a pressure-temperature tank which is accurate to $\pm 0.1^\circ C$ and to ± 0.2 per cent in depth. Temperature measurement was made with a thermistor resistance bridge which was carefully calibrated against a Bureau of Standards certified platinum resistance thermometer. The pressure gage was calibrated with a dead-weight tester. The bathythermograph was subjected to temperature calibration, pressure calibration, temperature-hysteresis and pressure-hysteresis cycles (figs. 6 and 7). These tests also showed the relative repeatability of the instrument.

TEMPERATURE

The temperature calibration curve (fig. 8) shows that the temperature error varied from $-0.1^\circ C$ to $+0.15^\circ C$. There was no change in calibration after exposure to $50^\circ C$ and 125 per cent of full rated depth, nor was there any temperature hysteresis shown.

DEPTH

Figure 9 shows the results of the depth-calibration tests. Because of the change in calibration characteristics, the manufacturer's representative was unable to correct fully the depth scales of the grid. Therefore the depth readings were taken at specified temperatures to duplicate the readings throughout the runs. In the temperature range of $5^\circ C$ to $11^\circ C$ the maximum error observed was -10 meters, while in the range of $23^\circ C$ the maximum error observed was -50 meters. The instrument showed no change in calibration after exposure to $50^\circ C$ and 125 per cent full rated depth, while the pressure hysteresis observed was one-half of one per cent of full-depth range or less.

LIFE TEST

The bathythermograph was subjected to 100 pressure cycles of full rated depth, each sustained at full rated depth for one minute. The instrument calibration was then checked with no change observed.

HYDROSTATIC PRESSURE

The bathythermograph was subjected to a pressure equivalent to 125 per cent of that encountered at full rated depth for a period of 5 minutes and the calibration was then checked. No leakage or change in the instrument's calibration was observed.

SPEED OF RESPONSE

A 16-mm movie camera was mounted above the bathythermograph so that the pen-arm movement could be recorded over the temperature test range. A record of the pointer against a grid background was obtained on movie film as the bathythermograph was shifted rapidly from water at 30°C to water at 5°C. The relative positions of the pointer were read from the film, converted to per cent of full travel and then plotted against time (fig. 10). The stylus moved through 90 per cent of its full travel in 0.72 second and completed 100 per cent of its travel in 1.0 second, which is within the requirements of the specification.

SEA TRIALS

Sea trials were made to determine the adaptability of the bathythermograph to operating conditions. Two lowerings were made, each to a depth of 1150 meters. A discrepancy of 0.3°C existed between the lowering and raising trace. This discrepancy was found to be due to an inaccurate temperature compensation of the temperature bourdon. During the lowering of the bathythermograph, the internal parts were at a higher temperature than the surrounding water, thus causing the instrument to record a fictitiously high temperature. After remaining at the depth of 1150 meters for 15 minutes, the bathythermograph became stabilized and recorded the true temperature.

INSPECTION

The instrument and accessories were inspected for compliance with the specification. Three discrepancies exist. The tension of the slide-retaining spring in the grid holder (fig. 5) is not great enough to hold the slide against the stop pin. The pressure-bourdon slide-carriage spring which holds the glass slide is too weak to prevent dislocation of the slide. The specification calls for the sound-velocity grids to be marked with isovelocity lines for every 2 meters per second, whereas Engineering Laboratories marked the grids for every 5 meters per second.

CONCLUSION

The bathythermograph as tested meets the specification with the following exceptions: the slide-retaining springs in the grid holder and the pressure bourdon carriage are too weak; the temperature bourdon is not correctly temperature compensated; and the velocity grids are not marked for every 2 meters per second.

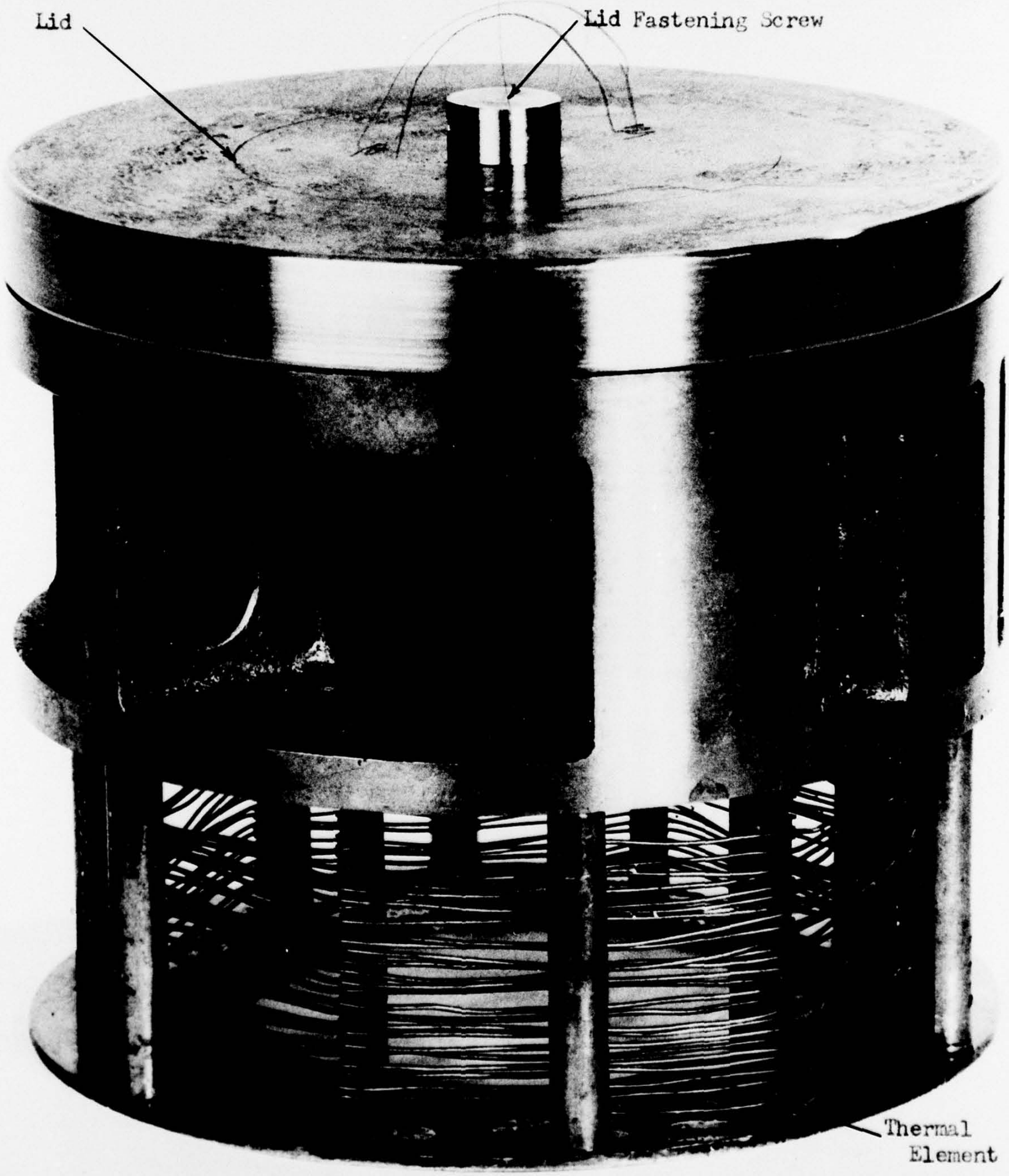
It must be noted, however, that the absolute depth and temperature calibrations were not checked.

RECOMMENDATIONS

The following improvements are recommended to bring the bathythermograph up to the requirements of the specification and to increase its reliability and performance.

1. Increase the strength of the carriage spring which holds the smoked slide to the pressure bourdon to prevent dislocation of the slide during the instrument's operation.
2. Lengthen the pressure-bourdon pivot shaft to prevent dislocation of the pressure bourdon because of shock.
3. Adjust the temperature-compensation section of the temperature bourdon to increase the accuracy of the instrument.
4. Waive the specification with respect to the marking of the isovelocity grids. It is believed that if the grids were marked for every 2 meters per second the instrument would be more difficult to calibrate and less readable.
5. Strengthen the slide-retaining spring in the grid holder to insure correct location of the slide.
6. Provide a shock mounting of the bathythermograph within its shipping container to minimize the effects of shock and vibration in handling and transportation and the consequent damage and shift in calibration.
7. Redesign the grid holder (fig. 5) to provide adjustable depth reference in case a slight shift of the depth calibration occurs and to aid in recalibration of the instrument.
8. Provide a tool to loosen the lid-fastening screw to aid in servicing the bathythermograph.

Figure 1. Bathythermograph, side view.



Preceding Page Blank - Not Filmed

[redacted]

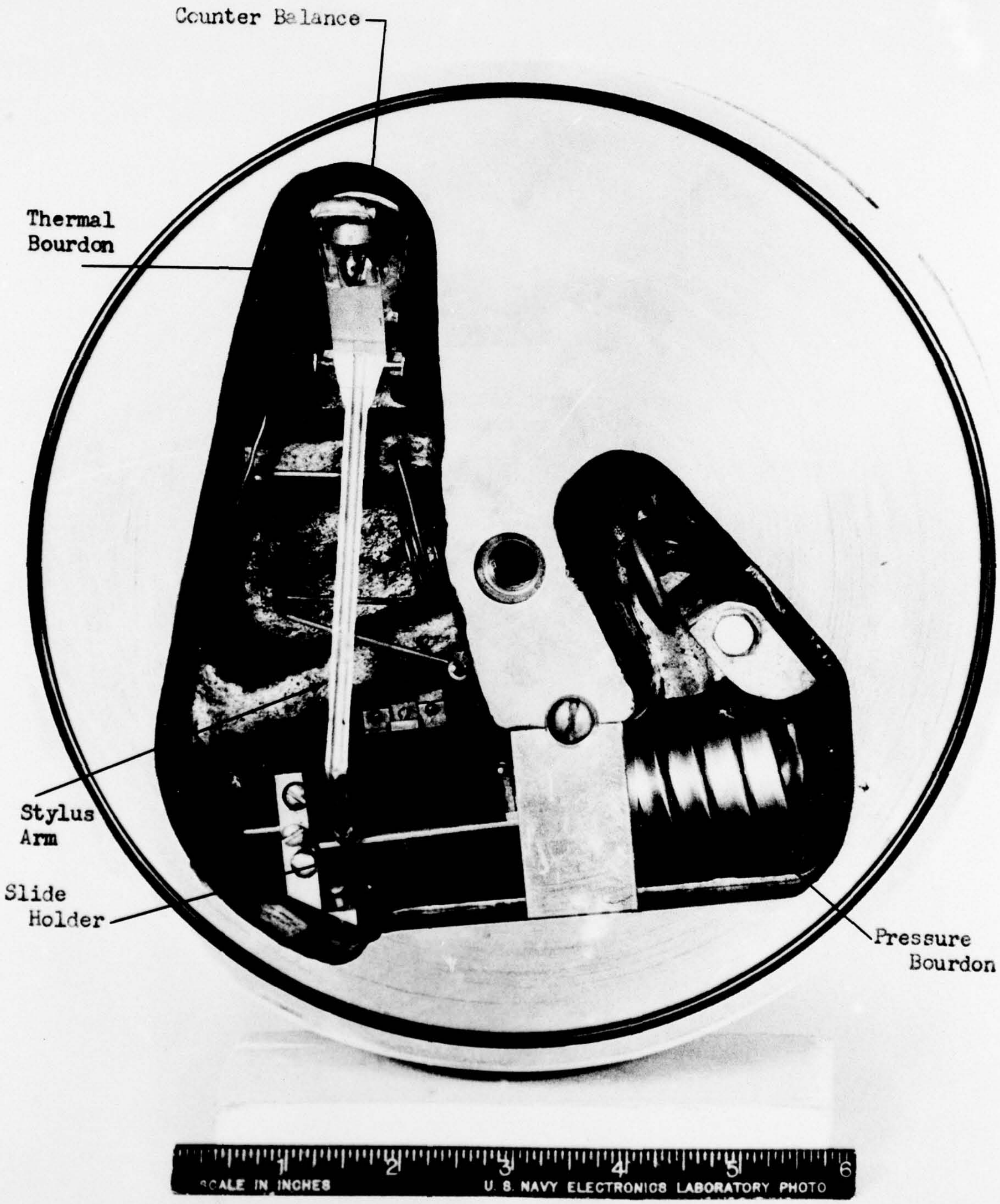


Figure 2. Bathythermograph, top view, with lid removed to show internal components.

Preceding Page Blank - Filmed

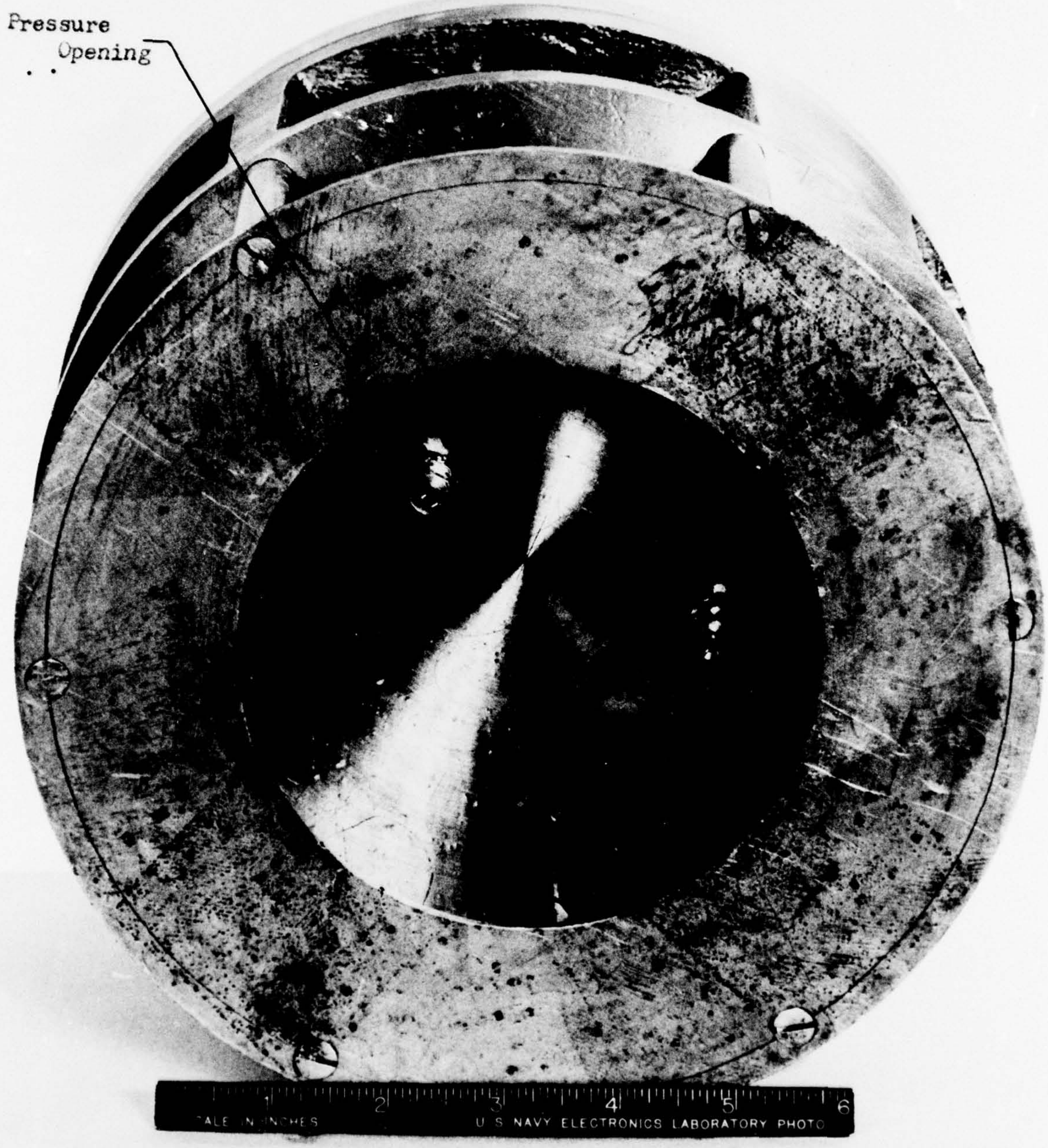


Figure 3. Bathythermograph, bottom view.

Preceding Page Blank - NOT FILMED

[redacted]

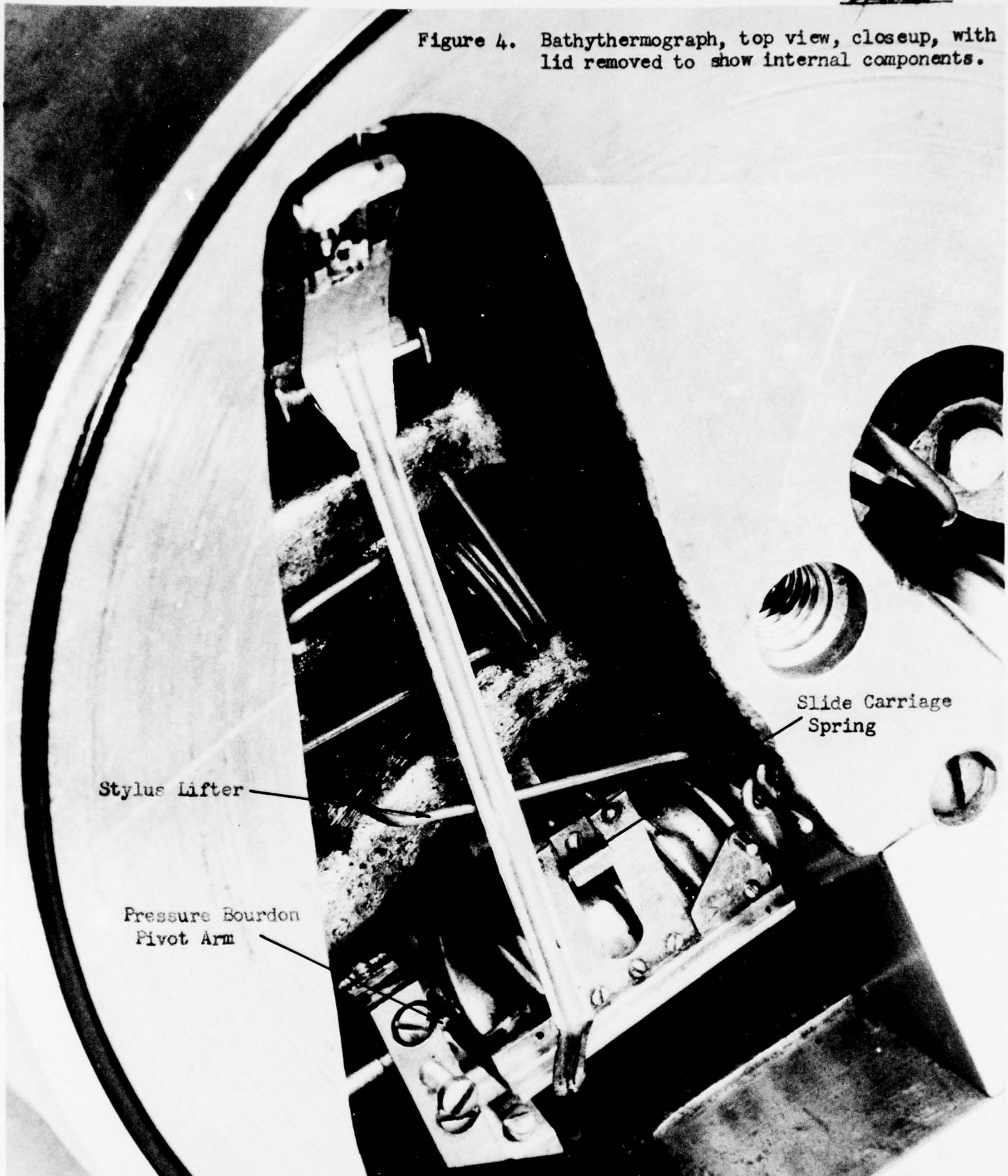


Figure 4. Bathythermograph, top view, closeup, with lid removed to show internal components.

Preceding Page Blank - Filmed

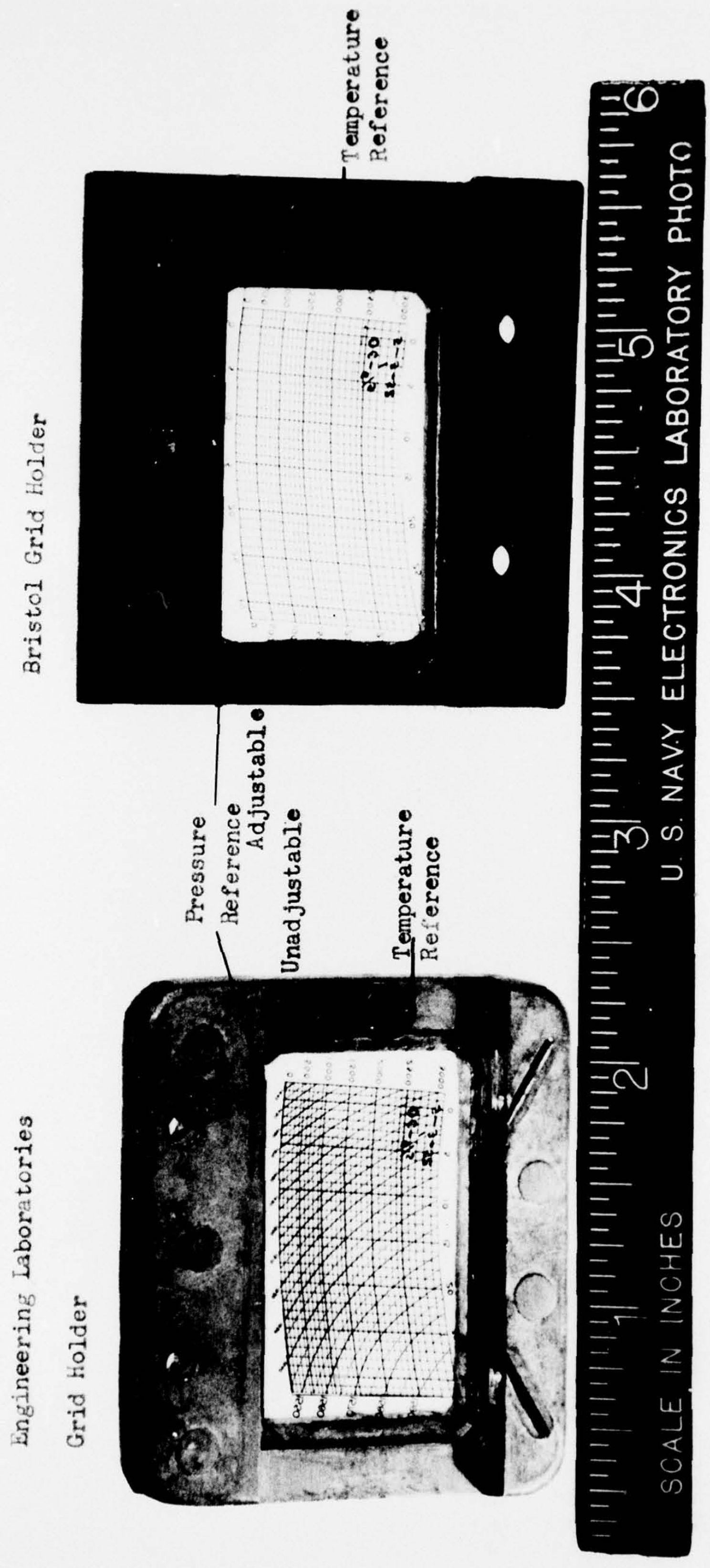
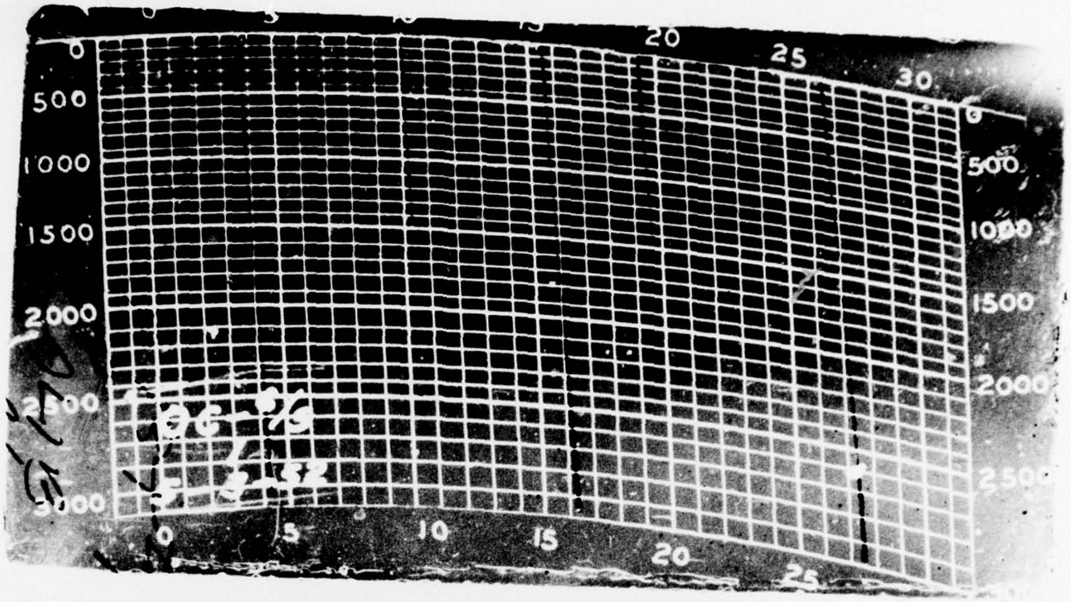


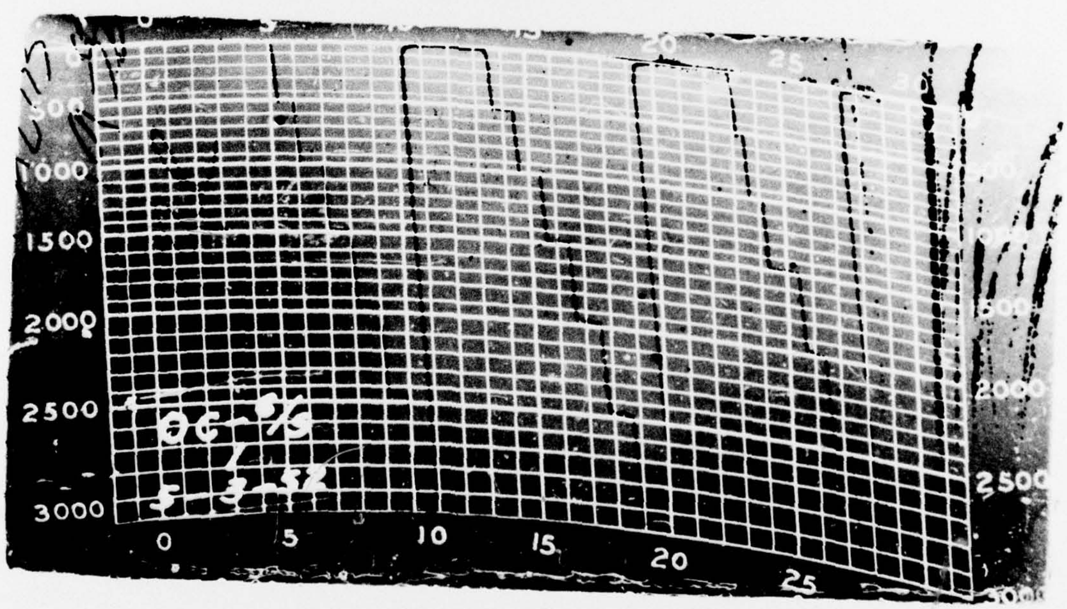
Figure 5. Grid Holders.

Preceding Page Blank - Not Filmed

[redacted]



Temperature Calibration Cycle



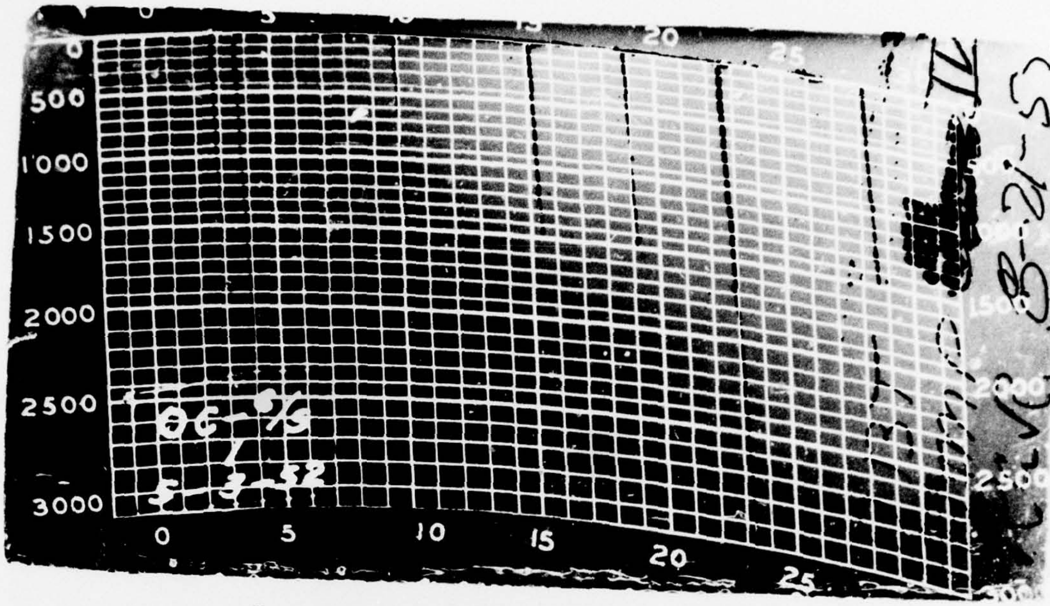
Depth Calibration Cycle

Figure 6. Temperature and depth calibration cycles.

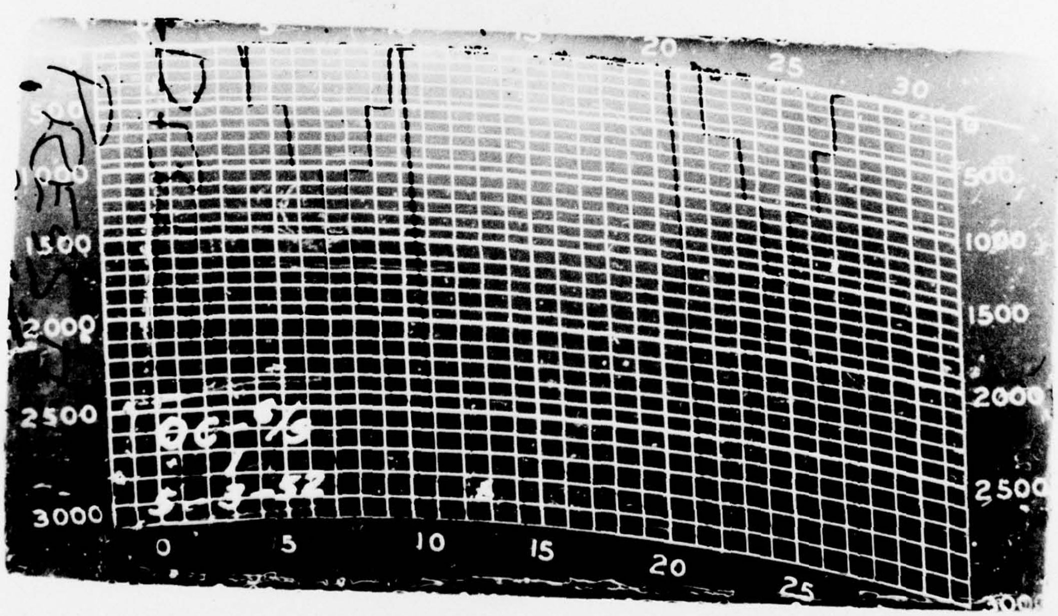
[redacted]

Preceding Page Blank - Filmed

[redacted]



Temperature Hysteresis Cycle



Depth Hysteresis Cycle

Figure 7. Temperature and depth hysteresis cycles.

[redacted]

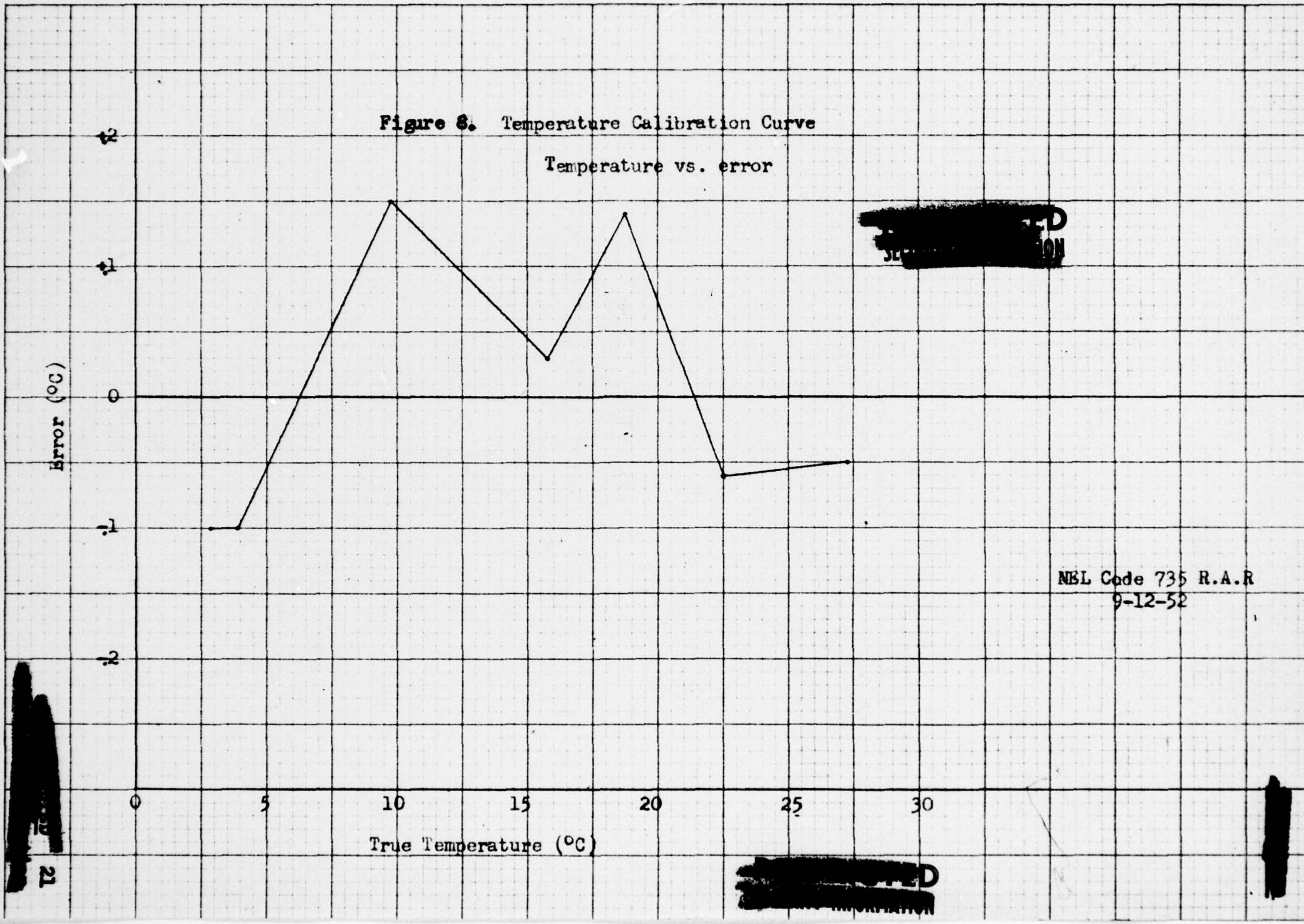


Figure 8. Temperature Calibration Curve

Temperature vs. error

[redacted]

[redacted]

[redacted]

Preceding Page Blank - Filmed

UNCLASSIFIED

[redacted]

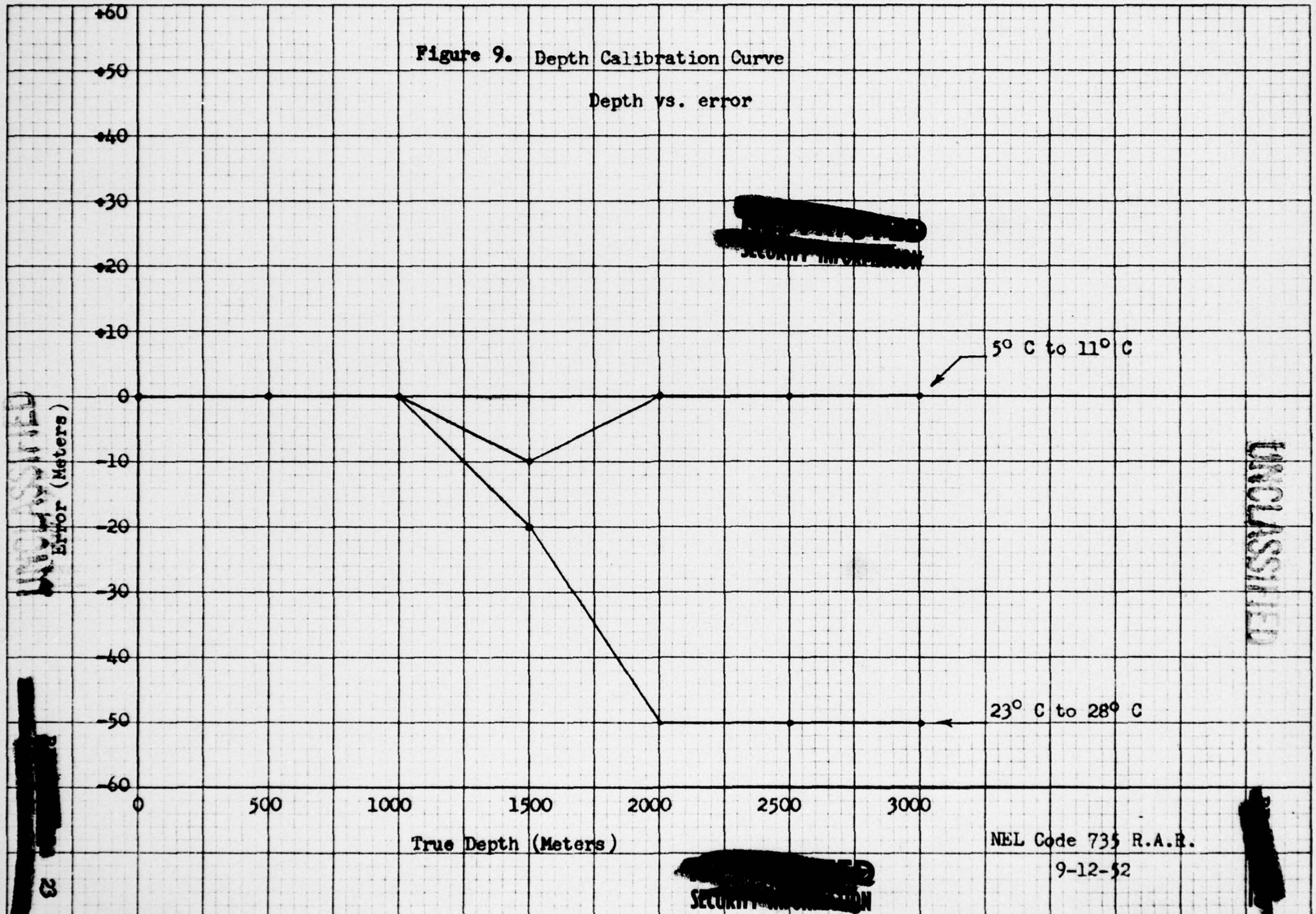


Figure 9. Depth Calibration Curve

Depth vs. error

NEL Code 735 R.A.R.
9-12-52

[redacted]

UNCLASSIFIED

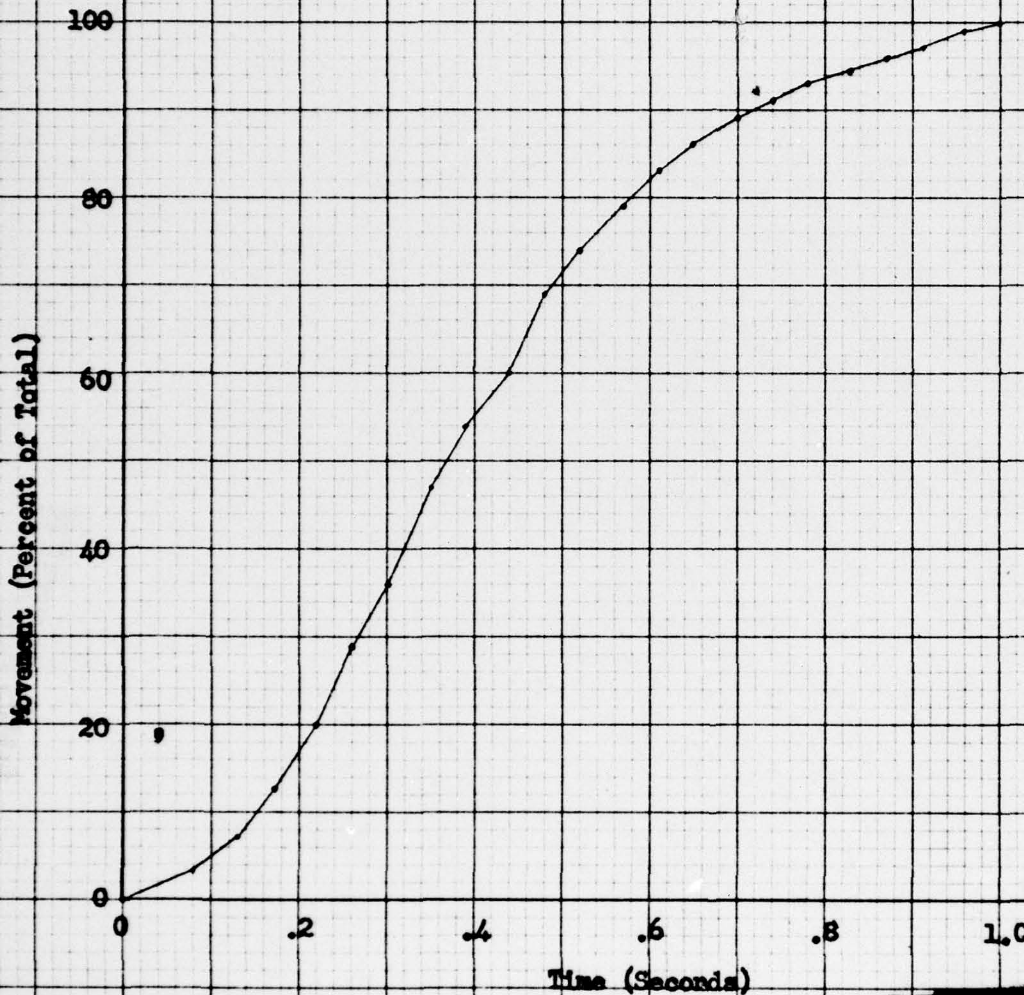
Preceding Page Blank - Filmed

UNCLASSIFIED

"ALBANENE" NO. 100L K&E CO., N.Y.
REG. U.S. PAT. OFF.
4901C

Figure 10. Speed of Response of Thermal Element

Time vs. percent movement



[redacted]
SECURITY INFORMATION

NEL Code 735 R.A. [redacted]
9-16-52

[redacted]
SECURITY INFORMATION

UNCLASSIFIED

Navy electronics laboratory Report no. 252
Evaluation of preproduction model surface-vessel bathythermographs OC-1/S, -2/S, and -3/S; service test report, by G.D. Shipway and H.G. Murray.
1 June 1951 9p. illus. UNCLASSIFIED

Abstract: Equipments tested do not meet the specification requirements. Inaccurate calibration and lack of repeatability of measurements in both temperature and depth were major discrepancies.

1. Model OC-1/S 2. Model OC-2/S 3. Model OC-3/S
I. Shipway, G II. Murray, H

Navy electronics laboratory Report no. 252
Evaluation of preproduction model surface-vessel bathythermographs OC-1/S, -2/S, and -3/S; service test report, by G.D. Shipway and H.G. Murray.
1 June 1951 9p. illus. UNCLASSIFIED

Abstract: Equipments tested do not meet the specification requirements. Inaccurate calibration and lack of repeatability of measurements in both temperature and depth were major discrepancies.

1. Model OC-1/S 2. Model OC-2/S 3. Model OC-3/S
I. Shipway, G II. Murray, H

Navy electronics laboratory Report no. 252
Evaluation of preproduction model surface-vessel bathythermographs OC-1/S, -2/S, and -3/S; service test report, by G.D. Shipway and H.G. Murray.
1 June 1951 9p. illus. UNCLASSIFIED

Abstract: Equipments tested do not meet the specification requirements. Inaccurate calibration and lack of repeatability of measurements in both temperature and depth were major discrepancies.

1. Model OC-1/S 2. Model OC-2/S 3. Model OC-3/S
I. Shipway, G II. Murray, H